Title: FLEXIBLE, PRJWIS1ON ON-ORBIT NAVIGATION AND
AUTONOMOUS EXPERIMENT MANAGEMENT USING GPS

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This paper de.scribes the flight navigation software for the TurboRogue GPS receiver. This
software uses a low order gravity model with a Runge-Kutta integrator to project and
smooth its trajectory solution over time and to protect onboard operations from anomalous
data. 1 t also provides for autonomous experiment cent rol.

The TurboRogue receiver was developed by JPL for NASA to meet high-accuracy
tracking requirements and a ruggedized version will be flown on two upcoming low-Earth
orbit spacecraft. The receiver produces dual frequency pseudorange and carrier phase
observables. An onboard RISC processor (AMD 29050) performs digital tracking,
navigation, data handling, and system management. In order to ready the TurboRogue for
on-orbit use, the cold-start Doppler search window was widened to include the range of
Dopplers seen from low earth orbit. To improve warm-start acquisition and to
autonomously schedule GPS-based science and other payload experiments an orbit
integrator has been implemented. Navigation and integrator precision are being improved
to provide 10 meter-level real-time positioning by incorporating better dynamic models
from precise orbit determination post-processing algorithms such as those used in J}'] .'s
GIPSY OASIS 11. The integrator is also used to screen incoming data for obvious
constellation or tracking anomalies, a form of Receiver Autonomous Integrity Monitoring
(RAIM).

Support for a very-low-average-p[~v'er GPS receiver which only operate.s for brief
intervals, periodically throughout the orbit is provided by another adaptation: fitting the
discrete data samples to a trajectory. Tests with actual flight data from TOPEX and GPS-
MET to demonstrate the feasibility and accuracies of this technique will be discussed.

This paper will report on test and operations I results for procedures designed to
autonomously determine the spacecraft orbit and administer the fright experiments and will
review work in progress on TurboRogue flight soft wa re as applied to specific missions.